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CHOICE OF THE ORGANIZATION STRUCTURE: A FRAMEWORK FOR QUANTITATIVE ANALYSIS OF INDUSTRIAL CENTRALIZATION/DECENTRALIZATION ISSUES

By

Peter Hammann

633-72

December 1972

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Thanks are due to Jean Rutherford for kindly and meticulously typing the manuscript.

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Abstract

Quantitative analysis of centralization/decentralization problems has so far mainly centered around the question of how decentralization might be achieved without departing from the system optimum, involving decomposition techniques of linear and nonlinear models. Positive effects, besides division of labour, of an application of the decentralization principle to a firm's organization were not taken into account. In order to do so, a decision model for a hypothetical industrial organization has been developed, leading to a comparison of the effectiveness of various more or less decentralized organization structures. The problem appears to be one in capital budgeting, where management is required to generate information of sub-unit performance through a heuristic routine. System alternatives may be ranked by one or more evaluation criteria, the one with highest rank, compared to present achievement, indicating steps toward desirable organizational change of the system. For simplicity's sake, the model, in a first stage, has been conceived as static and deterministic.

This paper is partly based on the author's habilitation theses (14), submitted to and accepted by the Department of Economics, University of Munich, July 1969 and February 1970, respectively.

Present research has been supported jointly by Technical University of Berlin and the Ford Foundation.

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The principle of task delegation or the division of labour is practically as old as mankind. What value can one, then, contribute to a quantitative analysis conducted on the question "Is delegation really worthwhile"?, if generally an affirmative answer has been supposed to be unavoidable? A closer look at the problem, however, will reveal several ambiguous underlying assumptions and hazardous generalizations due to some rather one-sided considerations of basic facts. Let us examine briefly the main pitfalls, which led to conclusions that seem to have lived too long, considering the lack of empirical evidence:

1. No clear distinction of tasks by their qualitative characteristics has been made in this context, thus dealing in an identical fashion with such different tasks as filling out an order form and the decision on the order quantity. From the point of view of delegating task both these show quite different implications due to quantitative dissimilarities and, therefore, different effects with regard to responsibility for their completion.

2. Delegation of task requires the evaluation of the various qualities and capabilities of those person(s) with whom tasks will be shared. If these persons are incompetent, task delegation might well prove to be disastrous. Likewise, their ability to cooperate will enhance or reduce the efficiency of the work of all concerned.

3. Not an isolated analysis of the necessity to delegate task at some particular hierarchical level is called for. Problems of task delegation can only be dealt with from the system's point of view in order to take interdependencies of communication and information into account. The decision to delegate task in some specific way depends on the joint effort of all

individuals in the system. The quality of a single individual's performance is irrelevant.

4. The various implications of delegation of management task, especially decision-making, have been studied from the system's point of view. However, analysis was conducted under the limiting assumption that the system optimum under centralization may not be violated. Thus, positive effects of task delegation, possibly leading to a higher system optimum were intentionally neglected. Moreover, management - in this context - is assumed to have perfect knowledge of the system's structure. Hence, delegation of decision-making would seem to be quite unnecessary. This sadly limiting view may have its fatal origins in the desire to give some economic interpretation to a well-known algorithm for decomposing large optimization models into a set of sub-models so as to solve them more swiftly and elegantly.

5. In many analyses, control over units to which tasks have been delegated is supposed to be exerted by prices, and/or goals and quota setting. Control by prices alone has been shown to be ineffective (7), not least because markets for commodities and services do not necessarily exist within a firm. Whether this is so or not depends largely on the adopted organizational structure itself. Especially, if decision-making is delegated, interdependencies of sub-unit decision processes may generate "markets" in which outside control (by central management) is required to arrive at decisions at all. However, the question remains, whether direct control media such as prices, goals or quotas will be accepted by the new decision-makers. Therefore, some subtler indirect control methods or combinations of direct and indirect methods seem to be called for which, alas, have not been investigated so far.

6. Motivation of individuals to whom tasks have been delegated is, typically, taken to be granted or irrelevant, when rigorous control methods are applied centrally. The latter may be true in some cases, but the case

itself, unfortunately, appears to be quite untypical. Motivational methods, therefore, will have to be taken into consideration, though it should be realized that - from the point of quantitative analysis - information on the effects of variations in these methods are extremely scarce.

7. Centralization of task, in particular decision-making, is assumed to generate economies of scale for a firm. This need not be true. It may hold in cases of simultaneous central planning. In fact, it depends on the completeness and accuracy of information at the central decision-maker's hands. The second point is that some sort of centralized decision-making is no issue at all for a particular firm. Therefore, economies of scale - if any - will have to be achieved in other, more viable or appropriate organization structures.

8. The conviction that economies of scale are generally at hand in centralized systems has led to another conviction; control must be exerted in such a way that these same economies are guaranteed, even when some (necessary) delegation of task takes place. Management, therefore, could be tempted to fake decentralized decision procedures that, eventually, have no value at all (see also (4) above). The procedures are time consuming and costly, possibly offsetting other benefits available. Moreover, they are too flimsy not to be understood by recipients of delegation who, in turn, could try to cheat the central decision-maker. Therefore, it seems to be quite improbable that any real-life organization would work along these lines.

Let us summarize. Traditional analysis has not centered around the problem whether decentralization in some particular form, if ever, should take place and if so, in which way. Attention has been focussed instead on the narrow and irrelevant issue, how some quasi-decentralization could be effected without violating the system optimum. As this is always known to management, decentralization appears to be initiated only when some "demo-

cratic soothing" of staff is appropriate. The influences of information, motivation and possible initiative of sub-unit decision-makers have been completely ignored. The task, therefore, seems to be clear. The problem should be restated as follows: Given that viable alternatives exist, which organization structure (and hence the degree of decentralization) should management choose if it wants to realize organizational change (see Bennis' concept (6), pp. 59ff.) in a firm? Finding an efficient, by no means supposedly optimal, organizational structure for a new firm may be a second task. However, it should be tackled, once the somewhat less bothersome first problem has been solved satisfactorily. We shall try to improve the mentioned defects of earlier research by incorporating the notions of information, motivation and initiative into the decision model. However, this model should only act as a framework for more detailed research related to practical applications. At this stage, we do not know enough about this many-sided problem so as to offer a thorough solution.

II.

For completeness' sake let us review very briefly relevant research done in recent years from which one should start in dealing with problems of this type.

The study that came nearest to the present one and (14) may well be the one done by Thomas Marschak (28). In this he tried to evaluate alternative organizational structures by a time criterion for decision and communication processes. Marschak's view, thus, is a partial one. It is of considerable interest as time considerations, in most real cases, will play an important role when analyzing problems of this kind, typically involving more than one decision criterion.

Decomposition theory is marked by such important papers as those of Dantzig (10), Dantzig-Wolfe (11), Baumol-Fabian (5), Arrow (1), Arrow-Hurwicz (2), Charnes-Cooper (8), Charnes-Stedry (9) and Koopmans (20), (21). Extensions and discussions on various limitations of the Dantzig-Wolfe model are given in Hass (16), Charnes-Clower-Kortanek (7), Geoffrion (13), Balas (4), who developed a different algorithm, Kronsio (24) and Ruefli (35). In the German literature H. Hax (17) has dealt extensively with the same problem. Ruefli's paper is of considerable value as it offers a goal programming formulation of the decomposition problem without recurring to a global objective set for the system (which is the starting point in all other papers on decomposition cited above). Moreover, his analysis emphasizes the hitherto ignored fact that the solution from the model, reached after a sequence of setting goals and prices, depends on the structure of the organization. Though the well-known implications of goal programming (especially the setting of goal weights) limit Ruefli's approach, his results point into a direction that further research might follow.

Kornai and Liptak (22), (23) have tackled decentralized decision-making by the assumption that management or a central decision unit exert control over sub-units in response to resource prices generated by the sub-units, as might be the case in centrally planned economies. The solution is found by reformulating the problem as a game.

The problem of optimizing a given organizational structure has been investigated by Hanssmann (15) as well as, more recently and in a more general fashion, by Mueller-Hagedorn(31), this being the lower-stage problem to the one under review.

The interested reader is also referred to the ideas and suggestions of J. Marschak(27), Radner (33) and McGuire (30) on the theory of teams for the sake of considering cooperative behavior of individuals in an organization, if required.

In this context, the system approach, at which this paper aims, has been most forcefully stressed by Sengupta and Ackoff (36), revealing a useful proposition on how to control a decentralized system.

Non-quantitative research has been conducted most extensively and the literature on it is far too vast to be listed or commented on here. Some particularly relevant findings will be cited later at appropriate instances.

III.

Centralization and decentralization of task are not absolute, but relative categories. If we are talking of "decentralization", we should bear in mind that it is the degree of decentralization (or centralization) which an organization has attained or is supposed to arrive at after organizational change has taken place, that matters. (See Albach (1), p. 112). Decentralization, at least in this context, will be defined as the simultaneous delegation of task and rights to decide on the task's best ways of accomplishment. (See Koontz-O'Donnell (19), pp. 336 ff.). The primary question will not be how decentralization may be effected but whether at all and to what degree it should be realized. It is clear that there cannot be a normative prescription of particular organizational structures for firms in general. The following methodology aims at providing a framework for individual evaluations.

We shall not deal in great detail with the interdependencies of organization structures and information system as has been done by Johnson, Kast, and Rosenzweig; (18; pp. 318ff.), Putnam, Barlow and Stilian (32; pp. 11ff.) or Richards and Greenlaw (34, pp. 267ff.). However, there seems to be some empirical evidence for the argument that an increase in quality and quantity of information might entail a trend towards centralization of management task.

Let us review more closely the reasons claimed for some sort of decentralization in industrial organizations, as defined above. It is because people on lower hierarchical levels often stay in a closer contact to concrete decision problems than management mostly does, that they might be given the rights to decide on the task delegated to them in order to create:

- a greater sense of responsibility
- better motivation
- a more intense commitment to their work.

This implies a division of labor and responsibility and should result in

- hopefully, some initiative on behalf of the "new" decision-makers (e.g., new production, marketing and investment alternatives)
- possibly, internal economies of scale.

They are facilitated through an increase in quantity and quality of information which is at the "new" decision-maker's disposal (viz. a new or - more often - improved way of planning) and reflects the closer contact he has to a particular task.

The main reasoning for an increase in centralization (or, equivalently, a decrease in decentralization), on the other hand, is the belief that the quality of planning, coordination and control within the organization might be brought about much more easily when a "central decision unit", whatever that may be, takes over or remains in charge. Apart from that, one hopes for economies of scale through more efficient resource allocation. These, then, are all hypotheses, in both cases. What one should not do, however, is to claim for an a-priori empirical and/or theoretical evidence for preferring one of these (in fact, many) alternatives (see also, e.g., Ruefli (35), pp. B-513f.).

If one sets out to "compare" different organization structures and their related decision processes, human behavior emerges as the crucial

and, possibly, most sensitive parameter of all. All human behavior, consciously or subconsciously, appears to be motivated by the kind or degree of identification of human beings with their environment. These facts are far from new. (See Simon (37), p. XVI). However, they will have to be considered very carefully in this context. In an industrial organization, to give just one relevant example, members of the central decision unit will try to motivate subordinate decision-makers quite deliberately. This is done with respect to management goals and/or decision alternatives by means of a variety of compensation schemes bound to a certain degree of accomplishment. This sort of motivation is certainly perceived as such by its recipients. (See March-Simon (26), pp. 34f. and pp. 52f). On the other hand, a central managment or decision unit should not feel too confident about the outcome of this. Monetary and other incentives may be, but need not be, taken up by the recipients or they just work once and fail the second time. There exists no such thing in an organization as built-in conformity or joint motivation of its members that might be exploited to the full when the need arises. (See, e.g., McGregor's theory Y (28), pp. 45f). Besides these very deliberate forms of exerted and perceived motivation there exists a variety of motivational influences which, typically, will elude a body such as a central decision unit which might be called for to decide on viable organizational alternatives. They are of a speculative nature and might best be described by such homonyms as aspiration and ambition. E.g., the fact that some particular task and rights to decide on it are delegated to a person on a lower hierarchical level may constitute (and there is some empirical evidence for that) some considerable motivational force though its impact may, likewise, diminish again with time. Analyzing the question whether and to what degree decentralization should take place in an organization will have to take such effects into consideration even if their

causes may remain unknown, nebulous or vague and even if there may be no way to influence or control them.

Control, in this study, will be effected by budgetary measures. The central management unit allocates a fixed budget to decentralized decision units. Budgeting may not be the only way to control an organization. However, it is a typical one, which may be encountered in many industrial firms. If we seek to compare structural alternatives we will have to ensure that a comparison will be a reasonably "fair" one. Introducing a fixed budget for all the firm's operations in any organizational form may be regarded as sufficient for the moment. Thus, the problem of evaluating more or less decentralized organization systems appears to be a problem in capital budgeting, the system alternatives being investment "portfolios" with uncertain earnings streams. In these "portfolios", the decentralized decision-making units, which themselves control a certain sub-system, represent the various investment alternatives. From these remarks, then, it will be absolutely clear that the problem at hand can only be solved from the system's point of view.

IV.

Let us illustrate these ideas with the help of a simple model which has been constructed to serve the purpose of demonstration of a methodology.

Let us assume that the firm manufactures m products in n different production departments (m≠n). The products can be marketed and sold without difficulties. Product markets are tangent, but not overlapping. The present organization is such that separate departments for different product groups have been formed, where all work is done. Thus, no competition arises

for jointly needed capacities. A total budget limits all managerial actions within and outside the firm. Acquisition of raw materials and other production factors shall be assumed as unconstrained. Its production will be sold immediately, inventories will not build up. This assumption is a basic one, reducing the problem to a static level. An entirely different model would have to be developed in order to take dynamic aspects into account.

We are going to compare the following three organizational structures for the decision process (see the discussion in (38), pp. 130f.):

1. Centralized decison-making by a central decision unit (simultaneous planning; see Fig. 1).
2. Decentralized decision-making in functional decision units such as marketing and production (successive planning, as production decisions are assumed to depend on prior marketing decisions; see Fig. 2).
3. Decentralized decision-making in product divisions (simultaneous planning; see Fig. 3).

A fourth alternative might be considered, too: decentralized decision-making in product divisions with successive planning of marketing and production decisions. We have left out this alternative somewhat arbitrarily because coordination and control in organizations such as this seem to be rather difficult to manage. However, the list of alternatives could be augmented without violating the methodological principles which we set out to demonstrate.

Alternatives 2 and 3 require a-priori management decisions on who is supposed to serve as decision-maker in the decentralized units. That is to say, the pertinent personnel assignments have to be effected - at least on paper - before an analysis can take place. However, it would be possible to check the problem under consideration with alternative assignment schedules. As will be seen, this might prove to be very costly because

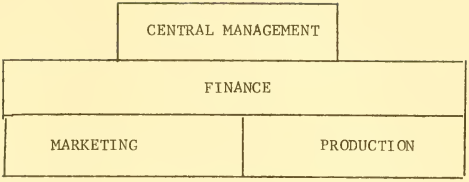


Fig. 1: Centralized Organization Structure

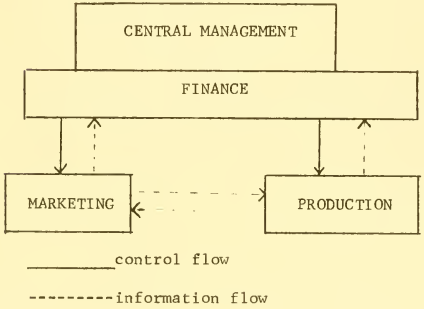
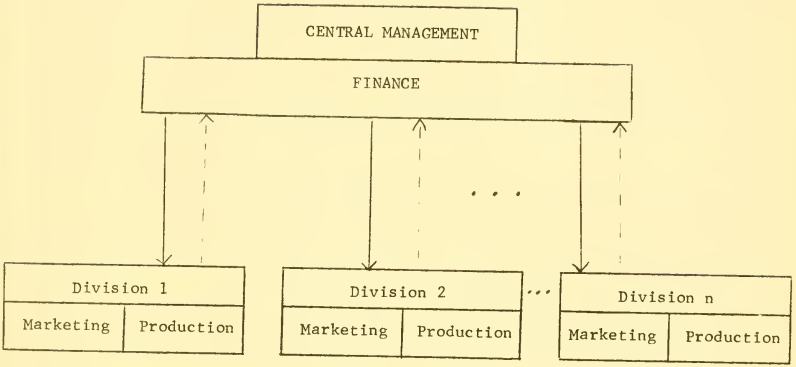


Fig. 2: Functionally Decentralized Organization Structure



_____ control flow

---------- information flow

Fig. 3: Divisionally Decentralized Organization Structure

nearly all of the heuristic routines would have to be repeated many times. As decision criterion we shall adopt profit or, equivalently, contribution to profit generated by the system. Other criteria might be considered, too. If we restrict ourselves to one criterion only we do so because information on other pertinent criteria is too sketchy as to be conclusive at this early stage of the analysis. Probably, Marschak's time criterion would be the one applied next. Whether it represents a system goal, is a matter of discussion. For simplicity's sake, we shall assume linearity to hold in all functional relationships. This can be defended, if variables are allowed only to take on values in certain limited ranges. We shall introduce several constraints to this effect.

In detail, we shall assume that advertising through different media is the only marketing tool. Market price will be held constant throughout. The firm is supposed to operate well below market saturation. Effectiveness of marketing instruments is considered to be discernible without lead time. Production in the firm starts out from actual orders held over from previous periods. We shall not deal with problems of obsolescence of machinery, as it does not add significant aspects to the analysis. It could easily be integrated into the model if necessity to do so should arise.

Let us put together the model for the first alternative. It turns out to be a quite conventional mixed integer programming formulation which can be solved by standard methods (such as the Brand and Bound Mixed Integer Programming technique, used in (14) by the author for numerical examples).

Let (in vector notation):

p = commodity price

c = variable production costs per unit

b = production capacity

A = matrix of technical coefficients

X = production quantity

W = advertising media quantity

V = matrix of advertising effectiveness coefficients

W* = maximum advertising media quantity

k = advertising unit cost

q^o = held over order quantity (to be served according to the FIFO rule)

F = fixed cost of the system (independent of decisions)

q* = maximum production quantity

S = quantity of added machine aggregates

Z = unit capacity of added machine aggregates

g = unit cost of added machine aggregates

x = attrition cost rate of added machine aggregates

B = total budget of the firm (less fixed cost)

Then the objective function of the central (and only) decision unit can be stated as follows:

4.1 maximize $Q_1 = px-cx-xgs-kw-F$ subject to

4.2 $cx + gs + kw \leq B$

4.3 $x \leq q^o + Uw$

4.4 $x \geq q^o$

4.5 $Ax \leq b + zs$

4.6 $w \leq w^*$

4.7 $s \leq s^*$

4.8 $x, s, w \geq o$

4.9 s, w integers

The model for the second alternative, on the contrary, appears to be far less detailed and "complete". In this case, decisions are delegated to two sub-units, one deciding on marketing activities, the other on production operations. For both of these sectors, separate budgets are allocated through the central decision unit where financial operations and control are retained.

It seems appropriate to postulate that the "new" decision-maker's should not be recruited from the central unit's staff if the accent lies on better information and initiative by decentralized authorities. Central decision unit members tend to have no better information as individuals. Moreover, the initiative incorporated in model (4.1 - 4.9) is their's anyway, most of the time. As marketing decisions have to be observed by the production department, successive planning is necessary. Initiative, apart from better or more accurate information, may be brought about through the act of decentralizing as such. However, this effect will fade with time. As we are concerned with system evaluation, we should suppose that central management will be willing to implement organizational change if this appears to be "worthwhile". It may be worthwhile if the gains through decentralization (i.e., by stimulating initiative) are big enough to offset possible future losses due to decaying initiative (or, equivalently, increasing routine). We will, at this stage, not be concerned with the problem of maintaining and stimulating initiative after organizational change has been carried through. This may seem, at first sight, to be a limiting proposition. However, two stages should be clearly held apart: the stage of organizational change and, what may be called, the "aftermath" stage. The second stage will not be entered without having passed through the first. If the a priori outlook for a transition is not good enough, central management will not be tempted to move. Therefore, we shall devote research effort to the aftermath stage later on.

If we are talking of initiative and its stimulation we should bear in mind where it might be discerned if brought forward. In our concept the following measures could possibly be taken by the new decision-makers:

- Increasing advertising effectiveness through the creation of new media or improvements on available media (change of lay-out or messages). Of course, an increase in cost would be the

consequence which, however, might be offset by higher earnings.

- Increasing manufacturing productivity through changes in production technology and/or initiation of economies on present technologies.
- Introduction of new products or product lines (if such initiatives would not have to be checked with central management before taking such steps).
- Additions to machine capacity and similar expandatory measures.

As we have noted earlier, better and more detailed information might be exploited, too. This will lead to two, possibly intertwined, effects:

- A new decision-maker may view the decision problem the same way as the central unit does. However, parameters will take on different values.
- A new decision-maker has an entirely different view of the decision problem's structure as compared to that taken by the central management unit (e.g., differences in perception of the nature of certain functional relationships).

From this follows that, contrary to the first of our alternatives, central management will have only a limited and rather vague knowledge of sub-unit performance. Therefore, it will be forced to experiment on it or estimate subjectively the possible outcomes of an organizational change.

Let us further assume that management tries to motivate sub-unit decision-makers by means of some profit sharing. Thus, we have two ways of motivation in this case: a monetary (i.e., profit sharing) and a non-monetary one (i.e., the act of decentralizing as such). Monetary motivation through some sort of profit sharing is quite common because it is directed towards goal motivation and initiative motivation. As we have noted earlier, however, it may not work. But we shall adopt it as a first hypothesis on central management action. The

rate of profit shared with sub-unit decision-makers will be assumed to be equal for all units throughout in order to exclude bargaining among them.

We are now in a position to formulate the models for the remaining two decision alternatives. Let us begin with functional decentralization, where initiative in any of the two departments, typically, will be counterchecked by the other in not following up for some reason (see Enthoven's comment on control of functionally decentralized systems (12), pp. 396ff.).

Let $f_1(B_1)$ = actual advertising expenditures

$f_2(B_2)$ = contribution to profit by the production department, dependent on

$g^*(B_1)$ = optimum allocation of promotional expenditures

Therefore $f_2(B_2)$ should be replaced by the notation $f_2\{B_2 \mid g^*(B_1)\}$

B_1, B_2 = marketing and production budgets, respectively

B = total budget of the firm, identical to B in 4.2

F = fixed system cost

C = vector of variable production costs per unit

q^o = vector of orders held over from earlier periods (to be served according to the Fifo rule)

β = profit share rate (a cost factor) granted to sub-unit decision-makers

Then the objective function reads as follows:

4.10 Maximize $Q_2 = (1-\beta)\left[f_2\{B_2 \mid g^*(B_1)\} - f_1(B_1) - F\right]$ subject to

4.11 $B_1 + B_2 \leq B$

4.12 $B_2 \geq cq^o$

4.13 $B_1, B_2 \geq 0$

The model, apparently, is a very simple one. However, f_1 and f_2 will have to be known to the central management unit, if evaluation is intended. As we shall encounter the same difficulty with model three, we shall postpone dis-

cussion on how to obtain these functions experimentally or by estimation for the moment. We shall, instead, proceed to write down the model for the third alternative (divisional decentralization), for which we hold the important (and no doubt, limiting) assumption that the organization of the firm may be broken down into independent divisions. Then let:

$f_p(B_p)$ = contribution to profit of division P (P = 1,---,H)

C_p = vector of variable costs per unit of division P

q^o_p = vector of orders held over from earlier periods in division P (to be served according to the Fifo rule)

The other symbols are retained from the model for the second alternative. Then the objective function can be written as follows:

$$4.14 \quad \text{Maximize } Q_3 = (1 - \beta)\left[\sum_{P=1}^{H} f_p(B_p) - F\right]$$

subject to

$$4.15 \quad \sum_{P=1}^{H} B_p \leq B$$

$$4.16 \quad B_p \geq C_p q_p^o \qquad (P = 1,---, H)$$

$$4.17 \quad B_p \geq 0 \qquad (P = 1,---, H)$$

As can be readily seen, models (4.10 - 4.13) and (4.14 - 4.17) have much in common. Again, f_p would have to be known for comparison of alternatives.

V.

Let us now turn to the important question of how the unknown return functions f_1, f_2, and f_p, respectively, can be obtained. There are, basically, two ways:

- Experimentation
- Estimation

As the situation faced by the central decision unit is a completely new one no historical data will be available as a preliminary guideline.

Experimentation in both alternatives two and three means that return functions would have to be established iteratively and heuristically. An a priori optimal allocation of the budget will be impossible. For alternative two one might proceed as follows:

Step 1: Set budgets B_1 and B_2 arbitrarily, however, observing restrictions (4) and (12). This could perhaps, also be done according to the financial requirements of both departments in the last period, which would have to be calculated post festum from secondary historical data.

Step 2: Transmit budget information to the marketing and production sub-unit decision-makers, selected previously.

Step 3: Optimization of marketing goals.

Step 4: Transmission of optimal marketing plan to the production department.

Step 5: Optimization of production goals. At this stage we may distinguish four cases:

(a) B_1 and B_2 are fully used up.

(b) B_1 is fully used up, B_2 only partly.

(c) B_1 is only partly used up. B_2 fully.

(d) B_1 and B_2 are only partly used up.

Therefore we have

Step 6: Information of central management on total profit contribution of the system and the financial status of the functional departments.

Central management may accept the arbitrary budget allocation as "optimal" if (a) holds. In case of (d) management should cut down the total budget of the firm - a very unlikely situation, however. In cases (b) and (c) a re-allocation of budgets seems promising and central management might be tempted to do so.

Thus, one goes back to Step 1 and repeats the routine. Iterations terminate if reallocations fail to bring additional gains, i.e., if we arrive at (a) or somewhere near to it. It is possible to set budgets arbitrarily several times, thus again obtaining points of the return function. These we can plot in both cases and a continuous curve may be fitted to the data, subsequently. However, as these experiments will be rather costly, central management might be well advised to follow the above routine. It can be necessary, on the other hand, to perform some iterations if one arrives at (a) already during the first round. It is important to keep in mind that the return functions will constitute some much needed information for future planning at the aftermath stage.

Let us summarize the information flow in the system:

From \ To	Central Management	Marketing	Production
Central Management	-	B_1	B_2
Marketing	1) Total Advertising Expenditures 2) Marketing Investment Expenditures	-	Optimal Marketing Plan (Market Constraints)
Production	1) Total contribution to Profit Minus Attritions Costs 2) Total Variable Production Costs 3) Production Investment Expenditures	(Planning Deadlocks)	-

Fig. 4: Information Flow in a Functionally Decentralized Organization

It should be noted that not all information emerging from the departments will be transmitted to central management. The above information appears to be necessary and sufficient. As the experiment shows some features of a real-world business game some psychological implications should not be overlooked. The designated sub-unit decision-makers may develop some routine when the experiment is run too often. Moreover, they may be tempted to fake initiative and pretend to have better and more information than they actually do. Hence, the experiment will have to be handled very delicately in order to avoid any such bias.

Much the same sort of reasoning applies to the generation of return functions for alternative three. The process is simplified as there will be simultaneous decision-making on production and marketing plans. The steps are now the following:

Step 1: Set budgets B_p arbitrarily, observing constraints 4.15 and 4.16. In this case, however, there will probably not be some sort of advance or historical information on actual financial requirements in the divisions.

Step 2: Transmit budget information to pre-selected division decision-makers.

Step 3: Optimization of division goals.

Step 4: Information of central management on divisional profit contribution and financial status.

As can be easily seen, independence of divisions reduces the information flow in the system to a minimum. Again, central management may accept any (more or less) arbitrary budget allocation as "optimal" if budgets are all used up in the divisions. One might stop repeating the experiment, possibly, when results turn out just to be a near miss of the "optimum". In all other cases, central management will be tempted to arrange budgetary shifts where

indicated to arrive at a different and, hopefully, more auspicious budget allocation. Iterations terminate when no shifts are possible or seem to be called for.

The second way to arrive at sub-unit return functions is, of course, some form of subjective estimation. There may be a variety of "clutches" which could be helpful to a manager seeking to arrive at reliable estimates. Little (25) has offered some suggestions how to do it which we can apply in this context, too, if some knowledge of the system's past performance is at hand. We may assume that some law of diminishing returns holds for the output of sub-units under budgeting. The return functions will approach saturation levels asymptotically as budget volumes increase (Fig. 5).

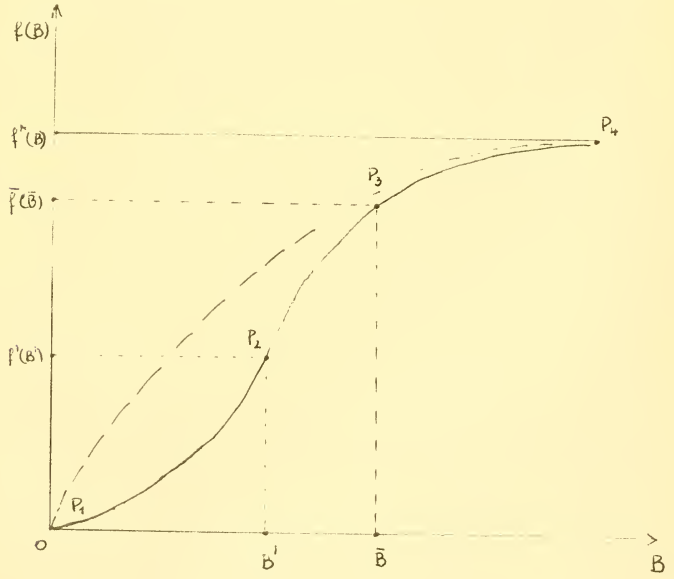


Fig. 5: Idealized sub-unit response on return function.

This response or return curve may be determined by four points:

- If budgets are reduced to zero, there will be no returns (P_1).
- During the preceding period, the sub-unit (under centralized decision-making) put out f'(B') on the basis of a budget B'. Central management, therefore, may hold the hypothesis that a similar performance should be expected under the adopted form of decentralization (P_2).
- Central management might ask for the necessary budget $\bar{B}$ if a 50% increase in returns over f'(B') was to be achieved (P_3).
- Central management will feel that there exists a saturation level f*(B) which constitutes a maximum limit to sub-unit output (P_4).

Through the four points we can fit a smooth curve as in Fig. 5. Algebraically, the curve would be of the following form:

$$5.1 \quad f(B) = f^*(B) \cdot \frac{B^{\beta}}{\alpha + B^{\beta}}$$

Where α and β are constant parameters, reflecting central management's expectations on the power and nature of decentralization response. Note that for $B = 0$, also $f(B) = 0$.

VI.

We have tried to provide a framework for quantitative analysis of organizational choice. The method has been shown with the help of three distinct structural alternatives:

- centralized decision-making
- functionally decentralized decision-making
- divisionally decentralized decision-making in contrast to earlier

research, the following important notions have been considered in the approach:

- quality and quantity of information
- motivation
- initiative

on behalf of sub-unit decision makers. Control is exerted through budget allocation. Point of view for the analysis has been the system.

As we have dealt primarily with methods, not results from the analysis, there may be room for a number of possible extensions. Here is a list of those which appear to be particularly fruitful for subsequent research and applications:

1. Dynamic modelling of the problem. To this purpose it might be useful to delegate management task, but not decision-making. Over several periods, then, the system's behavior could be studied, leading to a better understanding of work interaction at sub-central levels. With these results at hand, a decision of altering the decision process might be better supported.
2. Stochastic modelling of sub-unit response to management's motivational methods.
3. Experimentation on the effects of other motivational methods than profit sharing and decentralization of authority.
4. Study of the adaptive properties of control, possibly in conjunction with research done under position (1).
5. Study of interactions between divisions with regard to information flow and resource bargaining.
6. Investigations of initiative maintenance at the aftermath stage. Methods that spring to mind, in this context, are management training and post-experience studies.

7. Improvements on experimental design for information gathering on sub-unit performance.

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